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ABSTRACT

This study examined motor, academic, and behavioral performance of 38 nine-year-old Australian children who had been described as biologically "at-risk" from neonatal conditions. In addition to individual tests taken by subjects, school progress questionnaires were administered to teachers and parents. Subjects were found to require a greater amount of special education assistance than their classmates, and teachers rated them as having significantly more difficulty concentrating and following directions. Writing problems were also prevalent. Results indicated a need for attention to be given in areas of potential difficulty for these children and for specific teaching strategies to be learned to compensate for concentration and attention deficits which may be present. Since the "at-risk" category is quite broad, it is suggested that future research differentiate socioeconomic factors influencing the child's development in addition to neonatal impairments. Contains 22 references. (PB)

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SCHOOL PERFORMANCE AT NINE YEARS OF AGE, OF CHILDREN WHO WERE "AT RISK" AS NEONATES.

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Children's development is dependent upon a great variety of experiences and conditions. In particular, the extent to which birth and immediate post natal conditions influence future development, is the focus of much research interest and discussion. The developmental risk that infants born prematurely are likely to experience is complicated by associated factors such as low birthweight, small-for-gestational age and health difficulties such as respiratory and pulmonary conditions.

These sick, fragile, preterm infants, whose survival usually depends upon sophisticated perinatal care and medical technology are at risk of not only dying but of surviving with handicaps that will diminish their potential quality of life.

Neonatology, a paediatric specialty introduced in the 1960's, provides intensive care for the sick, newborn infant and during the past decade, several studies have noted an improved survival rate (Yu, 1985, Kitchen et al, 1986, Hunt (1981)). Davies and Stewart (1975), and Stewart et al (1981) believe that the increase in survival rates does not increase the incidence of severe handicap. However Walker et al (1984) and John et al (1983) are not convinced of the quality of life of the survivors, especially in the very low birthweight group of infants.

Developmental deficits, especially in VLBW children have been reported by Fitzhardinge and Ramsey (1973), Siegel (1982), Kitchen et al (1980) and reading and school problems have been noted in studies by Hunt et al (1982), Noble-Jamieson et al (1982), Eilers et al (1986) and Hertzig (1981). At school age, many studies have revealed that Intensive Care Nursery Graduates are likely to experience learning difficulties which require remedial or special education facilities. (Sell, Gaines, Gluckman, and Williams (1985)

This study investigates the academic, motor performance and behaviour of nine year old children who, immediately after birth, had been cared for in the Intensive Care Nursery at the Mater Misericordiae Mothers' Hospital in Brisbane

between July 1977 and July 1978. These babies may be described as having been biologically "at risk". This session will discuss only the academic performance of these children, at age 9.

Population:

The study sample was drawn from a population of 55 surviving children who were admitted to the neonatal intensive care unit of Mater Misericordiae Mothers' Hospital, Brisbane between July 1977 and July 1978. The mean birthweight was 1754 grams (range 700-3520 grams) and mean gestational age 32.6 weeks (range 26-42 weeks). These children had been followed prospectively since birth by the Growth and Development Clinic (Mater Children's Hospital, Brisbane). Table 1 presents the demographic and birth data for the study group.

Table 1 : Demographic and Birth Data

n = 38

	mean	S.D.	Low/High
Birthweight (grams)	1753.947	752.866	700/3520 gms.
Gestation (weeks)	32.658	4.002	24/42 weeks
Duration of neonatal hospitalization (days)		19.206	6/126 days
Socio-economic scale	3.294	1.219	1/6

Perinatal variables and distribution of birthweight, gestational age, small for gestational age, and days of hospitalization are detailed in Tables A-F in Appendix 1.

The 38 subjects (75% of the total eligible population) in this study were the children whose parents completed questionnaires and gave permission for me to either visit the child's school and assess the child's progress in reading, spelling, mathematics and handwriting, or to assess the child at home. The children of the group were located over the wide spread area.

Table 2 : Location of children

n = 38

Brisbane	23
Gold Coast	1
Northern New South Wales	5
Sunshine Coast	1
Darling Downs	5
Central Queensland	2
South-Western Queensland	1

Two children were not included. One of the children is severe intellectual retardate whose only means of communication is eye contact. The second had been involved in a car accident at five years of age, suffering intellectual impairment due to injuries received.

Classmates at each school were assessed on three of the tests given to the study children. The classmates were selected alphabetically from the class roll so the complete group numbered 3 boys and 3 girls, including the study child at each school. The total number in the classmates group was 136.

Methods:

A school progress questionnaire was completed by teachers for all children. The study children had an additional school progress questionnaire completed by their parents.

An assessment session at school for the study child and classmates was a group testing situation. In addition, each study child was given individual tests. The tests used are presented in Table 3.

Table 3 : Test Materials

Group Tests	Individual Tests
Reading : St. Lucia comprehension	Reading : Neale Analysis of Reading
Spelling : SIA	Handwriting : Handwriting Test -
Mathematics : Progressive	Occupational Therapy Dept. Uni. of Qld.
Attainment Test	Receptive Language : Peabody Picture
	Vocabulary Test.

The handwriting test investigated many components which are listed in Table 4.

Table 4 : Handwriting Assessment

Specification Table

	Handwriting components					
Items	Formation	Spacing	Spacing Range	Alignment	Size	Speed
Symbols	X	X	X	X	X	
Letters	X					
Words	X				X	
Sentence	X	X	X	X	X	
Short Phrase						X

Ziviani & Elkins (1984), p.256

Results:

All the children attend regular primary schools with only 17% of the "at risk" group having repeated a grade at school. 11% of the group of classmates had repeated a grade, as reported by the teachers.

Remedial reading had been received by 39% of the "at risk" group and 34% of the group of classmates.

Of the "at risk" group, 27% had received remedial mathematics and 14% of the classmates group had received remedial mathematics. (The total adverse responses on the teacher completed school progress questionnaire for the "at risk" children were significantly different to those of their classmates when a comparison was made using a t-test. (Table 5))

Table 5 : School Progress Questionnaire Responses for "At risk" group and classmates.

Outcome Measures	"At risk" (n=35) mean(SD)	Classmates (n=132) mean (SD)	t
School progress-(teachers) - adverse responses	3.714 (3.460)	1.553 (2.466)	4.209***
Behaviour - (teachers) - adverse responses	6.765 (6.742)	2.765 (4.242)	4.288***
St. Lucia - comprehension	27.528(15.519)	32.548 (9.977)	2.358*
SIA - spelling	38.000 (17.123)	43.800 (13.513)	2.157*
P.A.T. - mathematics	29.833 (10.958)	34.600 (8.456)	2.814**

*** p = .001, ** p = .005, * p = .02

Teachers indicated differences between the study group and their classmates on five of the questions of the school progress questionnaire (Table 6).

Table 6 : School Progress Questionnaire Results of "At risk" group and classmates.

	Value	d	p
. Does this child have any problems with writing?	18.862	1	.001
. Is this child achieving at grade level in mathematics?	16.051	1	.001
. Is this child able to follow directions?	9.205	1	.002
. Is this child's concentration adequate for him/her to complete his/her schoolwork?	11.801	1	.001
. Are you happy with this child's progress at school?	15.690	1	.001

When the "at risk" group was divided according to birthweight ($\leqslant$1500 grams, 1500 grams), and each, in turn compared with the classmates group, the LBWB ($\leqslant$1500 grams) group remained significantly different of all the questions as listed in Table 5. However, the heavier birthweight group was only significantly different on the question, "Is the child able to follow directions?"

Table 7 : Percentage of teachers' adverse response for VLBW and >1500gm on school progress questionnaire items

	≤1500 grams n = 20	>1500 grams n = 15
. Writing Problems	60%	46%
. Mathematic problems	50%	33%
. Inability to follow directions	15%	26%
. Concentration problems	35%	33%
. Unsatisfactory school progress	40%	23%

Table 7 lists the percentage of adverse responses for each of the items found to be significantly different when compared to their classmates.

Significant differences were found to exist between the "at risk" group and their classmates on each of the following tests.

. Progressive Attainment Test (Mathematics)

. St. Lucia Comprehension Test

. S.I.A. Spelling Test (Refer to Table 5)

An evaluation of the handwriting performance of the "at risk" group investigated many handwriting components.

A comparison was made between the norms of the handwriting test for the age group 9.1 - 9.5 years, and the performance of the "at risk" group grouped by birthweight.

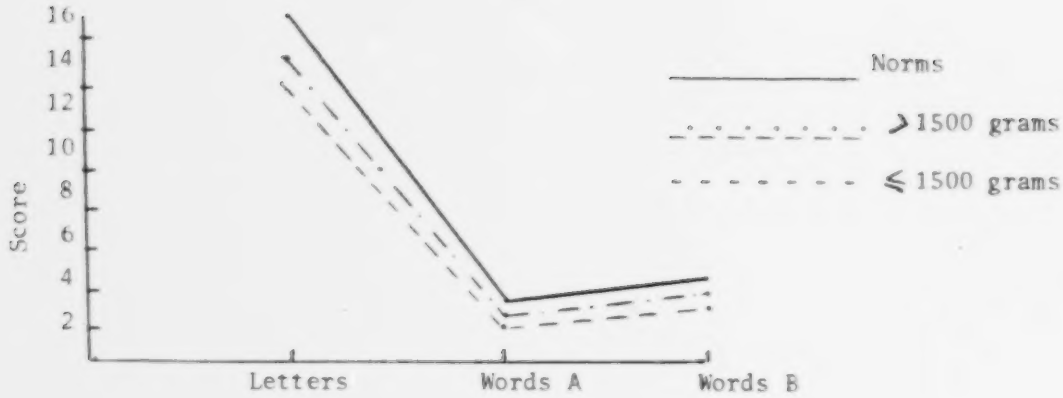

Figure 1 Performance of "at risk" group compared with norms on Formation of Letters, Words A, Words B.

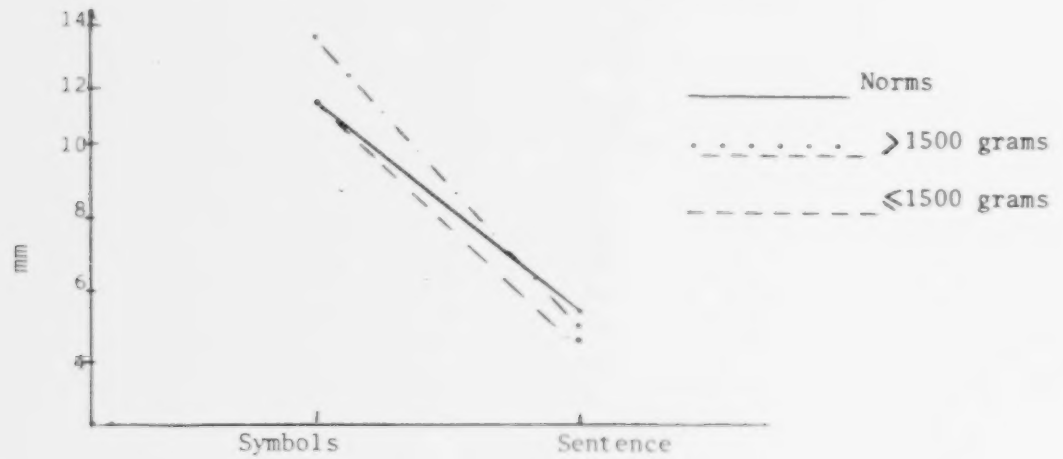

Figure 2 Performance of "at risk" group compared with norms on Spacing of Symbols and Sentences.

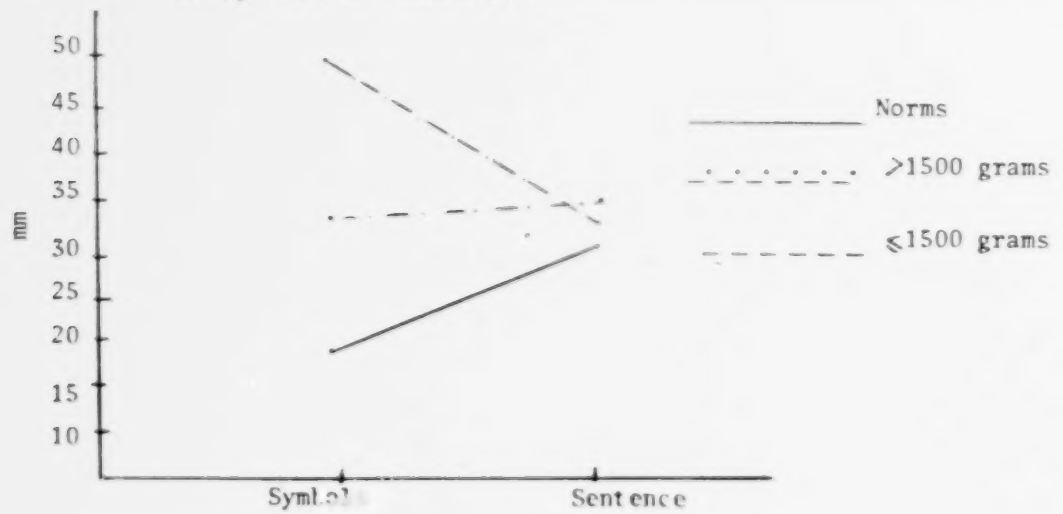

Figure 3 Performance of "at risk" group compared with norms on alignment of symbols and sentence.

When the scores were compared between groups based on birthweight, there were no significant differences.

Table 8 : Handwriting Components for Very Low Birthweight and 1500 gram children.

Components (Mean ± S.D.)	VLBW ≤1500 gram (n=19)	>1500 gram (n=16)	t
Symbols Formation	20.5(± 6.3)	17.6(± 7.2)	1.268
Symbols Spacing	13.6(± 5.9)	11.3(± 6.7)	1.078
Symbols Alignment	32.3(±14.4)	49.5(±24.0)	2.489
Letters	14.2(± 3.9)	14.00(±3.8)	.200
Words Formation	2.1(± 1.6)	2.2(± 1.5)	.197
Words Size	11.7(± 4.0)	11.87(±2.9)	.116

The Neale Analysis of Reading, an individual reading test with reading accuracy and reading comprehension components, was given to the "at risk" group. No significant difference was found to exist when grouped by birthweights. There were no significant differences between the Peabody Picture Vocabulary test results when grouped by birthweights.

Table 9 : Reading and Receptive Language Components for Very Low Birthweight and 1500 gram children.

Components (mean S.D.)	VLBW 1500 grams (n=20)	1500 grams (n=16)	t
Neale Analysis of Reading - Accuracy	53.6 (25.8)	52.4(24.2)	.145
Neale Analysis of Reading - Comprehension	18.6 (8.6)	19.5(10.4)	.295
Peabody Picture Vocabulary Test	101.6 (10.0)	95.8(26.0)	.839

Discussion:

The study population included all Neonatal Intensive Care Graduates available for follow-up at nine years of age. All were enrolled in regular primary school classrooms which supports the optimistic view of outcome for these sick, fragile newborns (Stewart et al, 1981).

The children were found to have a lower incidence of a repeated grade at school or the need for special education assistance than reported in the study of Sell (1985). However, the study children did require a greater percentage of special education assistance than their classmates (Michelsson, 1987).

Klein (1988) suggests that a critical issue in evaluating the long term outcome of beneficiaries of modern neonatal intensive care is their abilities to meet the demands of school and the ability to acquire basic skills during the primary years (p.48). The results of this study suggest the existence of difficulties experienced by the children consistent with other studies (Kitchen et al, 1980, Hunt, 1982, Holwerda-Kuipers, 1987).

Teachers rated the "at risk" children as having significantly more difficulty following directions and concentration than their classmates which supports studies by Klein (1988) Levine (1982). These difficulties compound the children's performance in their areas of school performance. Noble-Jamieson et al (1982), noted the arithmetic sub-test of the WISC-R to be significantly lower for VLBW children. The "at risk" group in this study were found to be significantly different to their classmates on their mathematics attainments in addition to their teacher's report, which supports Sell (1986).

Writing problems were prevalent in the "at risk" group of this study. Stewart et al (1988), Harvey et al (1982) suggest that low birthweight babies may exhibit a high incidence of minor neurologic impairments, which could result in difficulties in motor skills (e.g.) handwriting.

The findings of this study appear consistent with the description of the at risk infant as "one who displays increased school , ... and behavioral problems. (Rosetti, 1986, p.67). However, the limitations of this study are especially noted in the lack of reference to the socio-economic situation and

interpersonal relationships which exist between the "at risk" child and caregivers. The importance of these influences have been stressed as significant (Beckwith L. 1984, Cohen and Parmelee, 1983).

The pattern, however, that has emerged from the study of this "at risk" group of children at the age of nine, suggests to educators that there is a need for attention to be given to areas of potential difficulty for these children and sensitivity to the specific teaching strategies which may be required to compensate for concentration and attention deficits which may be present.

As the term "at risk" encompasses quite a heterogeneous group, and this study made no attempt at the factors which may predict school success, future studies could extend the parameters to include socio-economic factors influencing the child's development in addition to the perinatal influences upon later development.

Table A : PREINATAL VARIABLES

Number of Subjects	38
Birthyear	1977-1978
Sex	19 females: 19 males
Hospitalization	6-126
Selection	Parents' choice

Table B : BIRTHWEIGHT DISTRIBUTION (n=38)

Birthweight (gms)	Number
< 1000	3
1001 - 1500	18
1501 - 2000	7
> 2000	10

Table C : GESTATIONAL AGE DISTRIBUTION

Gestation (wk)	Number
26 - 29	9
30 - 32	10
33 - 36	14
> 36	5

Table D : DAYS OF HOSPITALIZATION

Hospitalization (days)	Number
< 15	7
16 - 40	13
41 - 60	13
> 60	5

TABLE E : SMALL FOR GESTATIONAL AGE DISTRIBUTION

Gestation (wk)	Number
29	1
32	1
33	1
34	1

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